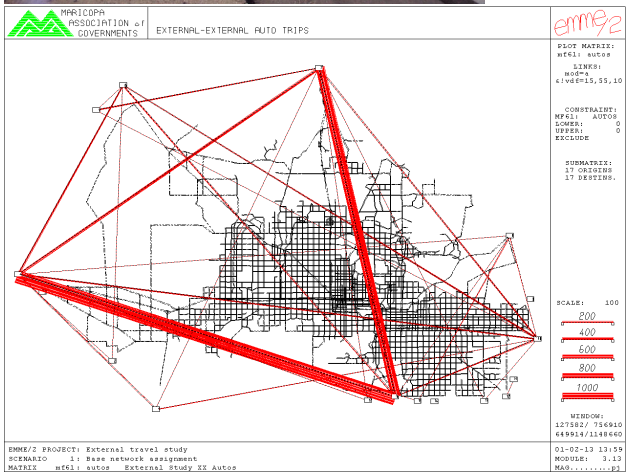
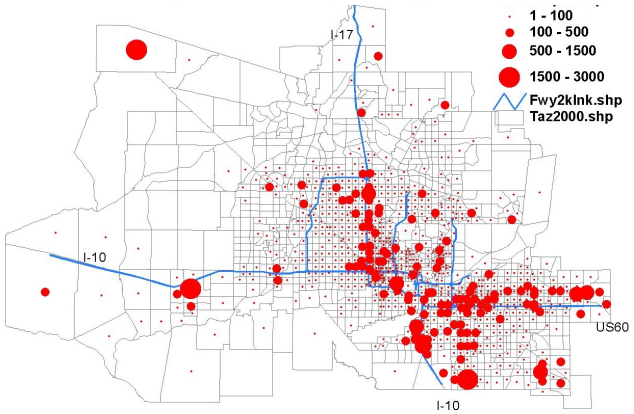
PHOENIX EXTERNAL TRAVEL SURVEY

EXECUTIVE SUMMARY





Prepared for

Maricopa Association of Governments
302 North 1st Avenue, Suite 300
Phoenix, Arizona 85003

Prepared by

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March 5, 2001

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Introduction

The Maricopa Association of Governments (MAG) performed the 1999 External Travel Survey as part of its responsibility for maintaining the regional travel demand forecasting model for the Phoenix metropolitan area. This vital tool is used for regional transportation planning and for supplying design volume forecasts for most major transportation projects undertaken by the Arizona Department of Transportation (ADOT), Maricopa County, and municipalities within the region.

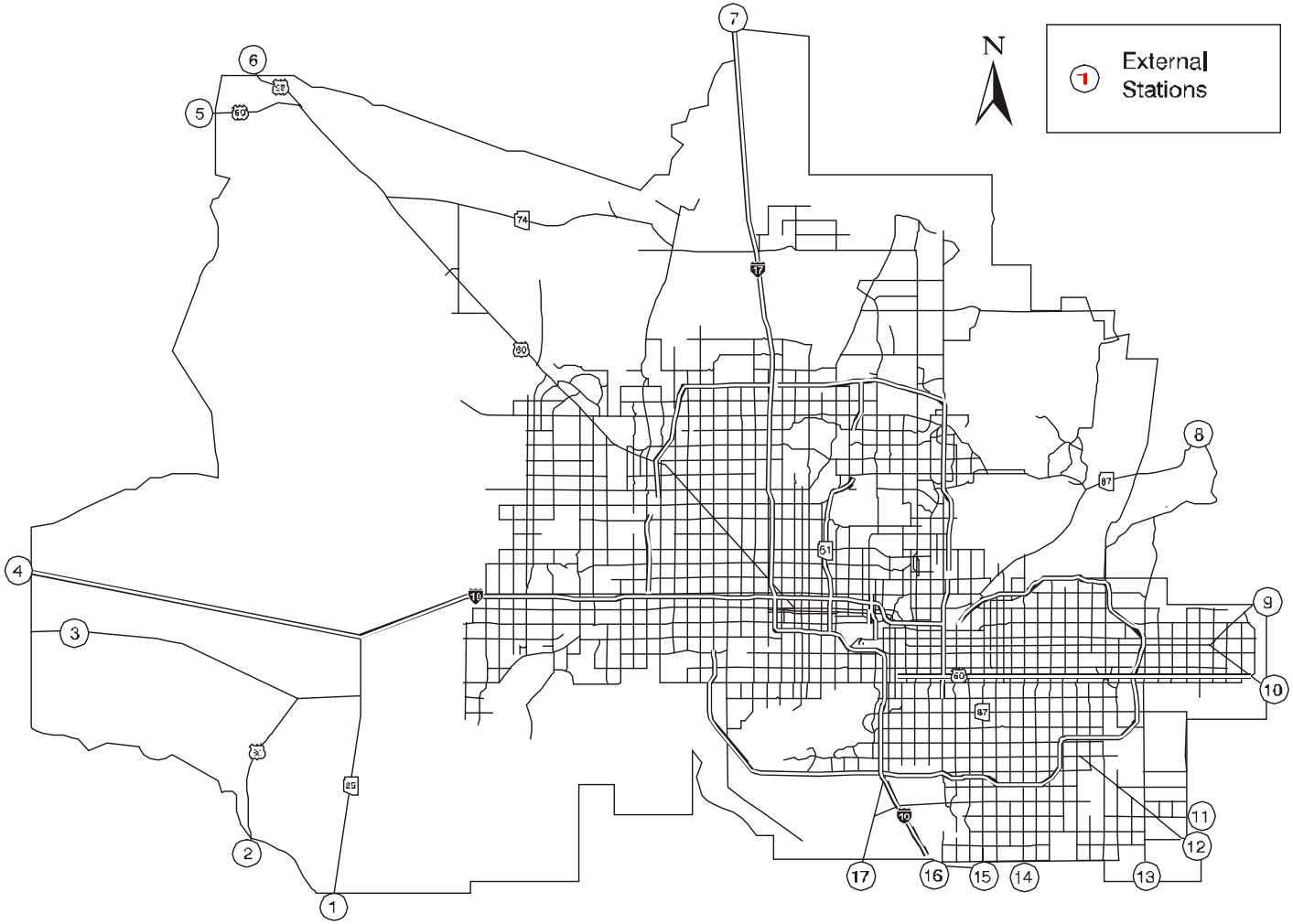
MAG is continuously involved in efforts to update the regional travel model. The external travel model component of the model estimates travel through the region (external-external, or through, travel) and travel into and out-of the region (internal-external and external-internal travel). The regional travel modeling area has increased significantly since the last update to the external travel model components in 1986. Thus, in addition to changes in external travel that may have occurred over time, there are changes in external travel due to the changing modeling area that must be properly reflected in the regional travel model. The results of the 1999 External Travel Survey are necessary to the continued production of high quality travel forecasts for the region.

The external survey was a traditional intercept survey where information on the current trip being made was collected. Roadside interviews were conducted at 15 external stations along the perimeter of the MAG study area (see Figure 1 and Table 1). These locations included three interstate highways, three US highways, four state highways, and five county roads. Two-day (48-hour) traffic counts were collected at each of the 15 external stations and two additional sites.

Table 1
Survey Samples

Site	Site Location	Surveyed Trips	Outbound Count	Percent of Outbound Traffic Surveyed	Inbound Count
1	SR-85 at Patterson Road	403	3,091	13.0%	2,726
2	Old U.S. 80 at Gila River	55	105	52.4%	93
3	Salome Highway east of Courthouse Road	69	155	44.5%	156
4	I-10 at 477th Avenue	647	7,264	8.9%	8,810
5	U.S. 60 at 355th Avenue	248	582	42.6%	574
6	U.S. 93 at Maricopa/Yavapai County Boundary	444	4,073	10.9%	3,740
7	I-17 at Maricopa/Yavapai County Boundary	1,003	16,513	6.1%	15,489
8	SR-87/Beeline Highway east of Bush Highway	541	3,308	16.4%	3,383
9	SR-88 south of First Water Road (counts only)	n/a	1,156	n/a	1,086
10	U.S. 60 about 3 miles southeast of Goldfield Road	961	10,357	9.3%	15,104
11	Ocotillo Road east of Meridian Road	298	1,603	18.6%	1,507
12	Rittenhouse Road at Combs Road	242	944	25.6%	928
13	Hunt Highway 1.7 miles east of Ellsworth Road	322	1,312	24.5%	1,368
14	Gilbert Road south of Hunt Highway (counts only)	n/a	1,029	n/a	1,066
15	SR-87 at SR-87/SR-587 Junction	475	5,319	8.9%	4,753
16	I-10 south of Hunt Highway	677	19,465	3.5%	19,343
17	SR-347/Maricopa Road south of Hunt Highway	464	4,741	9.8%	5,373

Figure 1
MAG External Station Sites



Survey Procedures

A simple procedure was used for selecting the sample for the roadside survey. First, the number of required surveys for each site was estimated considering the estimated traffic volume at the external station and the desired confidence level (95%). An "over-sample factor" of 15 percent was also included to account for loss of surveys due to data errors. On Interstate freeways, sample sizes were doubled. The targeted numbers of surveys ranged from 330 for low-volume county road stations to 910 for high-volume interstate highway stations.

Each of the proposed sites was visited before any surveys were scheduled to review conditions in the field and finalize the site location and the traffic control requirements. During the site visit, consideration was paid to ambient traffic conditions, apparent sight distances, prevailing speeds, presence/absence of shoulders, auxiliary lanes, and roadside development. Photographs and sketches were prepared of the proposed survey site.

In order to obtain approval on the necessary permits and provide the survey crew with a safe working environment, traffic control plans were prepared showing the devices needed to conduct the survey. These plans reflected the existing roadway geometry, signing, temporary traffic control devices such as signs and cones, and the interviewer refuge area. The traffic control plans were prepared in accordance with the Manual on Uniform Traffic Control Devices (MUTCD) and Arizona Department of Transportation (ADOT) guidelines. ADOT, Maricopa County, and other agencies were given the opportunity to extensively review these plans before their approval was granted to conduct the survey.

Prior to conducting surveys within public rights-of-way, permits were obtained from Maricopa and Pinal Counties, local municipalities, and several districts of ADOT. Formal permit applications for each site were obtained from each agency having jurisdiction over the roadway at each external survey site. These applications contained a statement of the work and precise location, the schedule and duration of the work, insurance certificates, and the initial traffic control plan.

The surveys were conducted between sunrise and sunset on Tuesdays, Wednesdays, and Thursdays over the five-week period starting September 14, 1999 and ending October 13, 1999. Vehicle classification counts were collected simultaneously with the surveys. These counts were used along with the survey data in order to perform the expansion of the data to represent the full driving population at the survey site. Mechanical classification counts were taken using a method by which each vehicle was counted as a specific type (passenger car, bus, 2-axle truck, multiple axle truck, etc.).

Vehicles to be surveyed were pulled in "platoons," or groups, equal to the number of interviewers present at a survey site. The intention of the vehicle selection process was to pull vehicles randomly. However, safety procedures dictated that certain vehicles be allowed to pass without any attempt to stop them for survey reasons. These vehicles were generally observed to be traveling at a high rate of speed or in closely packed platoons.

Once the platoon arrived at the survey location, drivers from each vehicle were interviewed simultaneously by the assigned survey personnel. After the surveys were completed, the vehicles were released and the next platoon was pulled. This process continued throughout the survey period. The site supervisor monitored survey progress and instructed interviewers and flaggers to increase or decrease the turnover rate to achieve the desired number of surveys.

Completed survey forms were edited and transmitted to MAG for data entry. Once the data were entered by MAG, they were checked for errors by using a database program. Checks included verification of data ranges, consistency of data items internal to the record and between records, and reclassification of “other” categories whenever possible. The cleaned data were then geocoded (the process of assigning a latitude and longitude to the place information). MAG determined latitudes and longitudes for all 726 truck surveys and 6,146 auto surveys included in the final data.

Results Summary

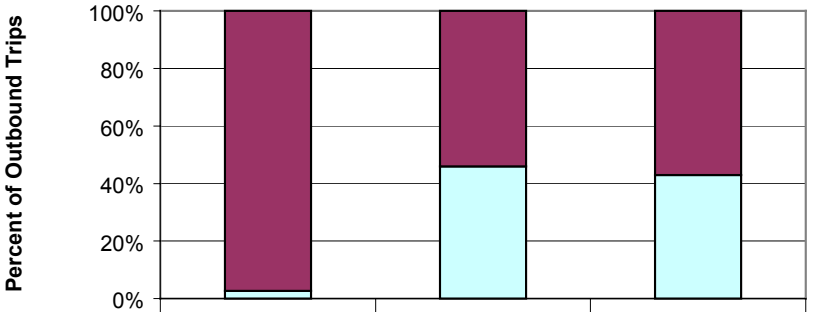
The following provides a snapshot of the internal-external travel into and out of the region and external-external travel through the region. Many of the results summarized in this section are based on "expanded" survey data. Typically, when a survey of some sector of a population is conducted, it is impractical to ask each survey question of each member of that population. Therefore, a random sample of the population is surveyed, and the results are expanded to reflect the entire population.

Because traffic and travel varied over the course of the day, the survey data were expanded for different time periods of the day. In addition, separate expansion factors were calculated for automobiles (and other personal use vehicles such as minivans and pickup trucks), "medium" trucks (step vans, buses, and single unit trucks), and "heavy" trucks (combination trucks).

The results summarized below are based on survey data and, as a result, are affected by inherent sampling error. Based on the sampling procedures used and number of samples collected, the maximum error for the percentage of vehicles having a certain characteristic is about ±5 percentage points.

Figure 2 provides information about the residence location of travelers leaving the area in automobiles and other personal use vehicles. While the information was collected from only outbound travelers at the external survey sites, symmetry can be assumed. There is no reason to assume that inbound travelers would have any different characteristics. As can be seen in Figure 2, only three percent of the travelers passing through the study area are residents of Maricopa County, whereas residents of Maricopa County made 46 percent of the internal-external trips.

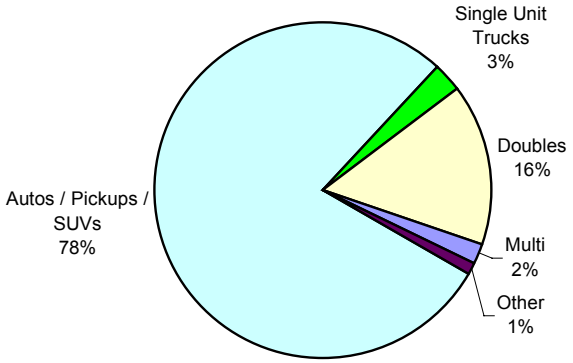
Figure 2
Percent of Total Trips by Residence Location of Trip Maker



	External-External	Internal-External	Total
Other	97%	54%	57%
Maricopa	3%	46%	43%

Figure 3 summarizes the proportions of inbound and outbound trips at all external stations by the type of vehicle making the trip. The information in Figure 3 was summarized from the mechanical classification counts performed at the external stations for the survey expansion.

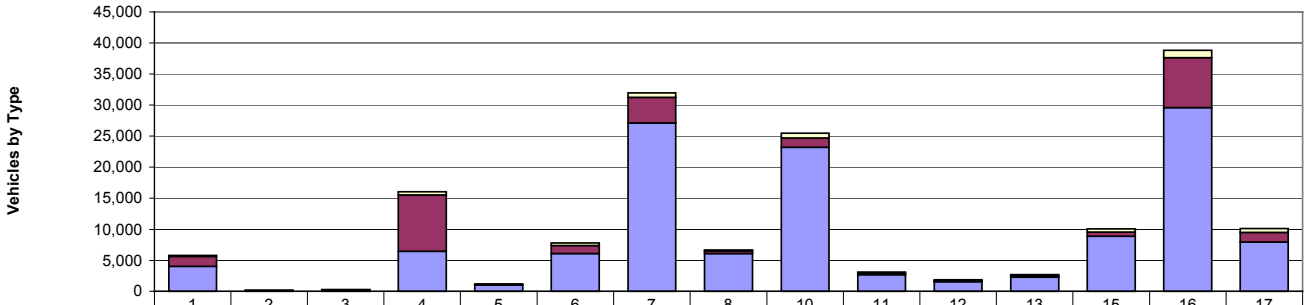
Figure 3
Percent of Total Trips by Vehicle Type



Passenger cars, pickups, minivans, and sport utility vehicles comprise almost 80 percent of the traffic at the external sites while single unit and multi-unit trucks comprise a little over 20 percent of the traffic. Other vehicles as summarized in Figure 3 include motorcycles and buses.

Figure 4 combines vehicles by type into the three broad categories used for expansion purposes: autos, medium trucks, and heavy trucks and summarizes the distributions of those vehicle types at each external survey site. As with Figure 3, Figure 4 is based on total traffic in both directions at each station as summarized from the classification counts taken at each station. The mix of vehicles varies substantially by site. It is interesting to note that trucks comprise about 60 percent of the traffic at the I-10 at 477th Avenue site (Site 4).

Figure 4
Total Trips by Vehicle Type by Station



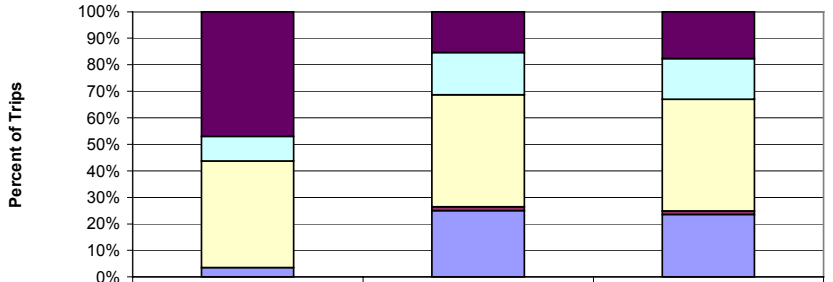
	1	2	3	4	5	6	7	8	10	11	12	13	15	16	17
Medium Truck	181	16	20	559	38	416	762	165	739	213	161	247	500	1,178	604
Heavy Truck	1,581	11	11	9,020	60	1,295	4,155	452	1,505	196	133	144	678	8,049	1,518
Auto	4,055	171	280	6,495	1,058	6,102	27,085	6,074	23,217	2,701	1,578	2,289	8,894	29,581	7,992

Station Number

Figure 5 summarizes the total outbound auto trips by the general purpose of the trip reported by the driver of the vehicle for both internal-external and external-external trips. General purposes were determined based upon the activities reported at the origin and the destination of the trip. All trips with home as either the origin or the destination were considered home-based trips. The home-based trip purpose was further subdivided based on the activity at the non-home end of the trip. Work and work-related activities were aggregated into the home-based work (HBW) trip purpose, school activities were assigned to the home-based school (HBSchool) trip purpose and all other activities were assigned to the home-based other (HBOther) trip purpose. Trips where neither end was home were assigned to non-home-based trip purposes. The non-home-based trip purpose was subdivided into work-related and other. Work or work-related activities were reported for at least one end of non-home-based work-related (NHB-WR) trips. All non-home-based trips where neither end involved a work or work-related activity were assigned to the non-home-based other (NHB-O) trip purpose.

The distributions of trip purposes by trip orientation (external-external or internal-external) are substantially different. As would be expected, very few of the external-external trips are home-based work or home-based school. These trip purposes would be repeated with some regularity, so the typical long distances required for external-external trips would preclude many of these trips from being captured in an external station survey. The trips that were captured probably included infrequent home-based work-related trips to a site other than the normal work site, home-based work trips made to a remote site where the person would stay for multiple days, and shorter home-based work trips that "cut the corner" of the study area. Almost 90 percent of the external-external trips were home-based other or non-home-based other trips. These purposes include trips that would be made for recreational purposes.

Figure 5
Percent of Total Outbound Auto Trips by General Trip Purpose



	EE	IE	Total
NHB-O	47%	15%	18%
NHB-WR	9%	16%	15%
HBOther	40%	42%	42%
HBSchool	0%	1%	1%
HBW	4%	25%	24%

The distribution of trips by purpose for internal-external trips mirrors distributions that are normally reported for regional (internal-internal) trip making. Typically, home-based work trips comprise 15 to 25 percent of the travel made by households in the region, home-based other trips (including home-based school trips) comprise 40 to 50 percent of the travel, and non-home-based trips comprise 25 to 35 percent of the travel. When home-based school trips are summarized separately from home-based other trips for a region, the home-based school proportion is typically between 5 and 10 percent of the regional travel.

Figure 6 summarizes the percentages of outbound auto trips by auto occupancy. As can be seen, over one-half of the auto trips had only the driver as an occupant. The average auto occupancy of the outbound trips, 1.65 persons per auto, is higher than average auto occupancies normally observed in metropolitan areas. The auto occupancy is, however, quite reasonable for internal-external and external-external trip making.

Figure 6
Percent of Total Outbound Auto Trips by Auto Occupancy

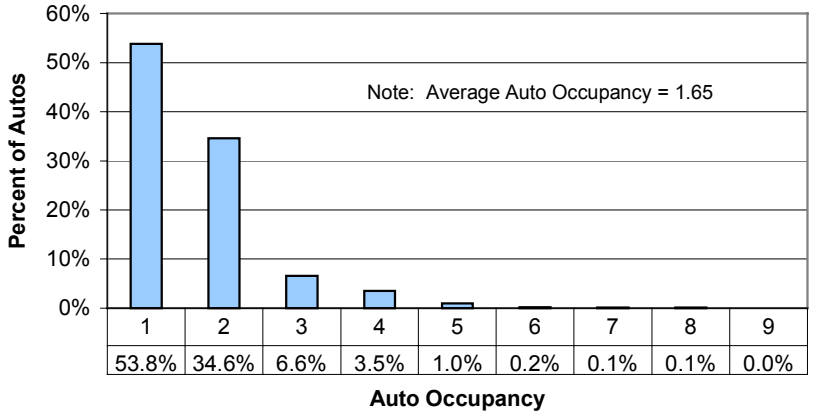
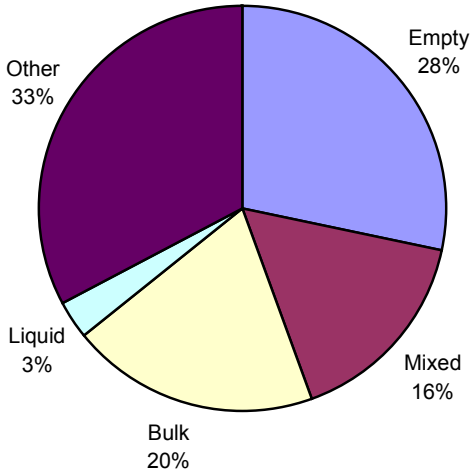


Figure 7 summarizes the distribution of load types carried by outbound trucks. The bulk category includes all unpackaged dry commodities such as cement, coal, dry chemicals, etc. The mixed category includes all packaged materials such as computers, grocery items, etc. The liquid category is used for all tanker trucks. The other category includes all other commodities such as cattle, auto transports, heavy equipment transports, etc. Perhaps the most interesting item summarized in Figure 7 is that over one-fourth of the trucks traveling through the external station sites were empty.

Figure 7
Percent of Total Outbound Truck Trips by Load Type



Figures 8 through 10 show the distributions of internal-external origins throughout the region for autos, heavy trucks, and medium trucks, respectively. As can be seen in Figure 8, internal-external auto trip origins are relatively well dispersed throughout the region. There is some clustering along the major transportation corridors and several concentration points near some of the stations. As shown in Figures 9 and 10, heavy and medium truck trip origins tend to be more clustered than the internal-external origins of autos. Many of the heavy truck trip origins tend to be clustered around I-10 and I-17 in central Phoenix. These concentrations are logical and can probably be correlated with major industrial and warehousing areas.

Figure 8
Origins of Internal-External Auto Trips

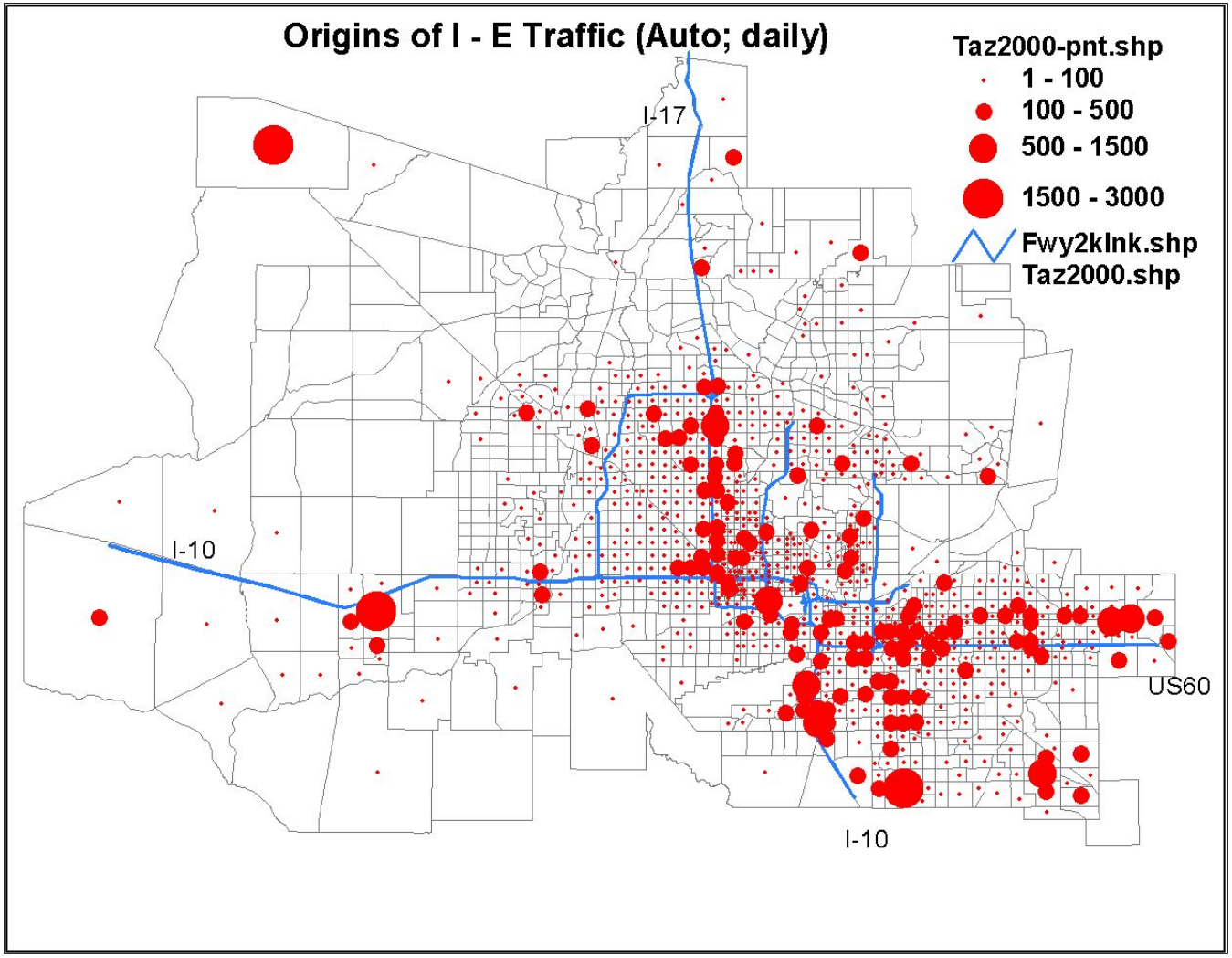


Figure 9
Origins of Internal-External Heavy Truck Trips

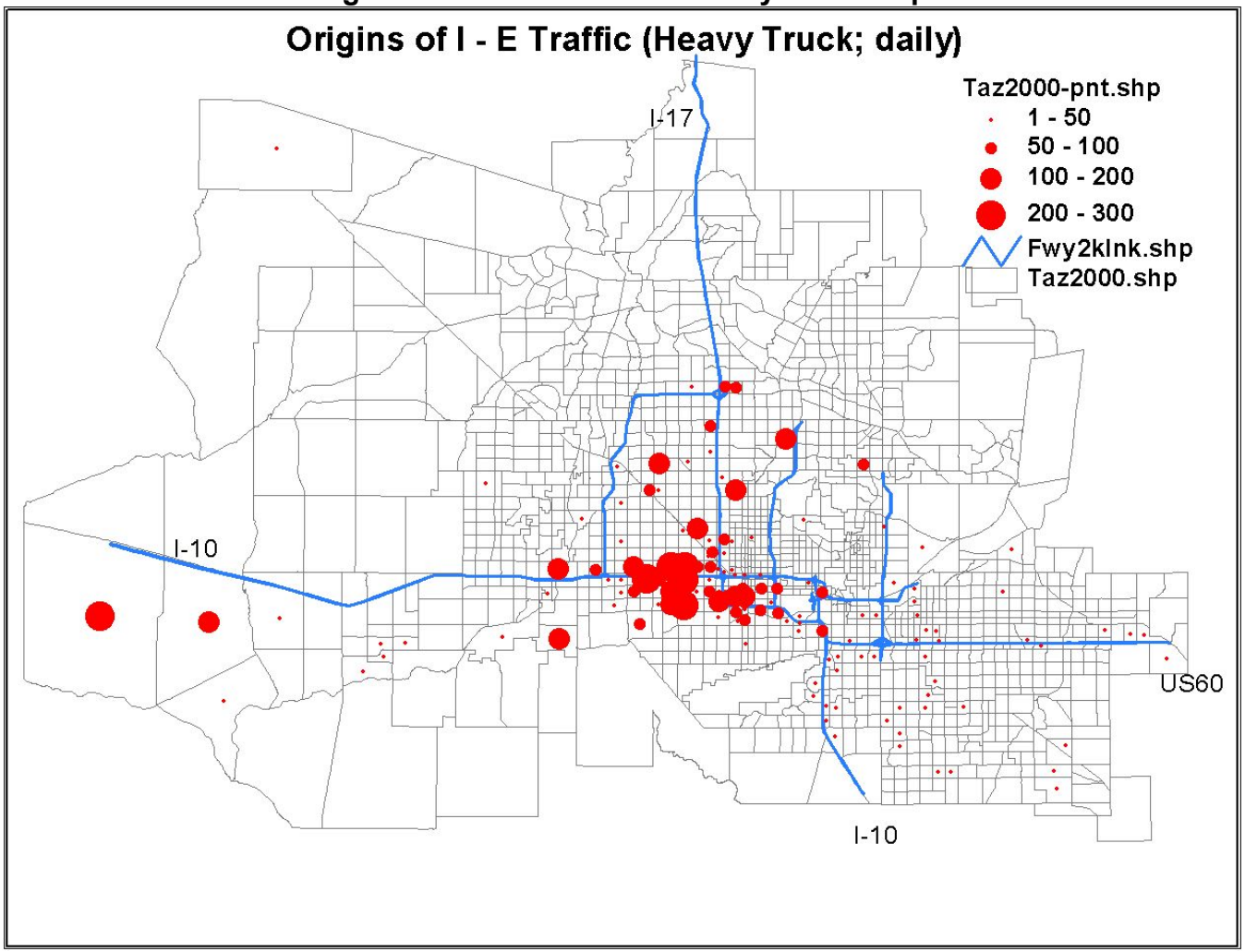
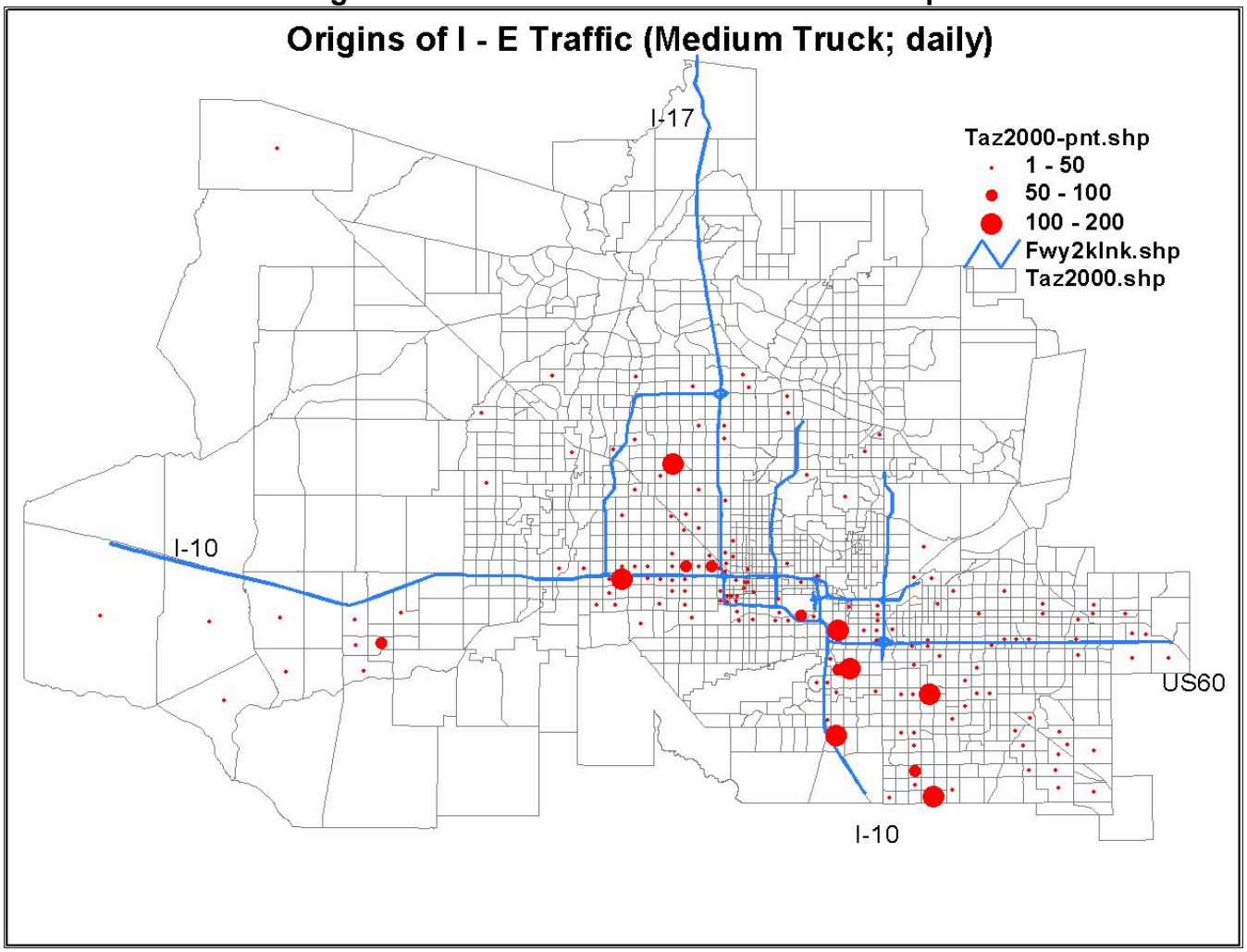


Figure 10
Origins of Internal-External Medium Truck Trips



Figures 11 through 13 show the destinations reported by drivers of vehicles leaving the region. Destinations for both internal-external and external-external travel are shown for all vehicle types in Figures 11 through 13. The primary destinations outside of the MAG region are in Pinal and Yavapai Counties, followed by Pima and Coconino Counties (see Figure 12). Within Pinal County, the major destinations are Casa Grande, Kings Ranch, and Queen Creek. The major destinations within Yavapai County are Prescott and Black Canyon. The close proximity of Kings Ranch, Queen Creek, and Black Canyon to the MAG regional travel modeling area suggests that close attention should be paid to those areas over time. In the future, methods for modeling trips to and from those areas might need revision to treat them more like "internal" zones rather than modeling trips to and from those areas through external stations.

Figure 13 shows the nationwide destinations of trips leaving the MAG region. Texas and California are the primary destinations followed by Nevada, New Mexico, and Mexico. The destinations suggest and east-west flow through of traffic through the MAG region as might be expected due to the continuity of I-10.

Figure 11
Destinations of Internal-External and External-External Trips — Neighboring Counties

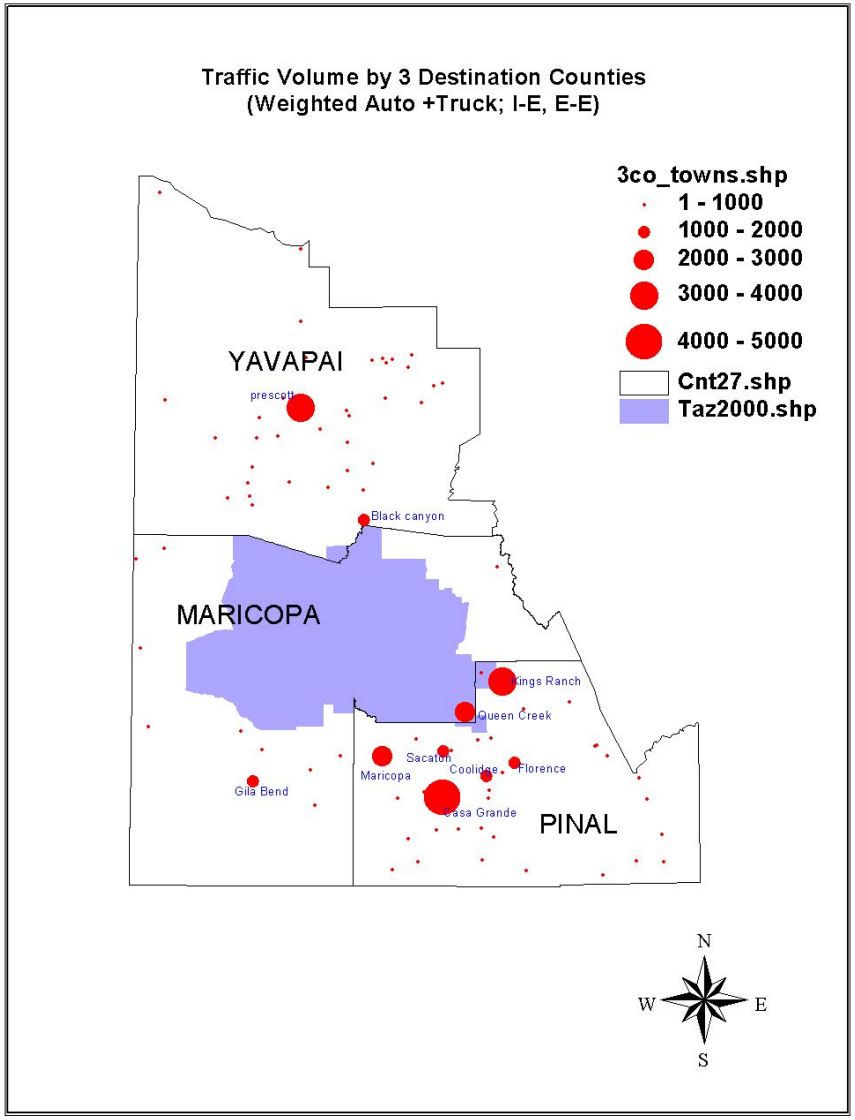


Figure 12
Destinations of Internal-External and External-External Trips
All Arizona Counties

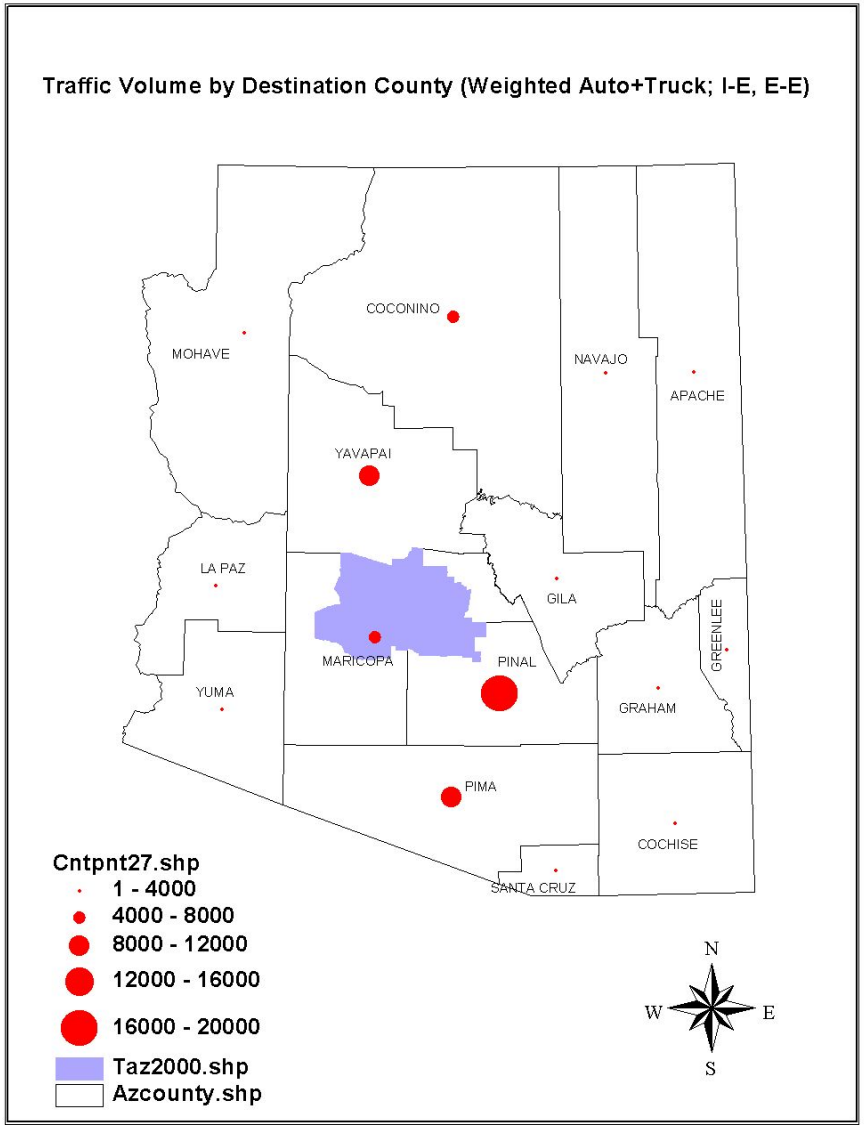
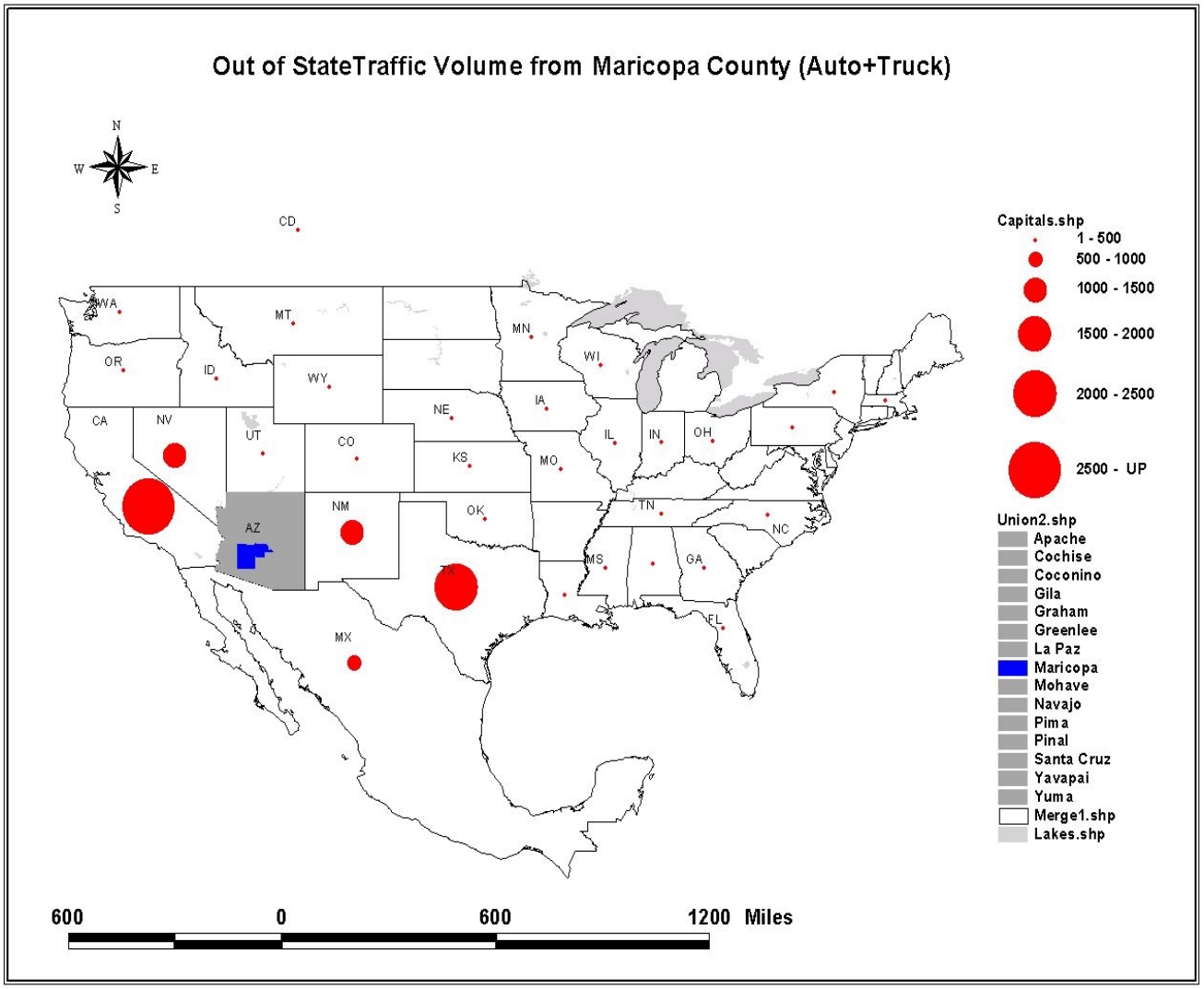


Figure 13
Destinations of Internal-External and External-External Trips
US, Mexico, and Canada



Figures 14 and 15 further show the major flows of external-external trips through the MAG region. The major flows for auto are between I-10 on the west and I-10 on the south and between I-17 on the north and I-10 on the south. For trucks, the primary flow is between I-10 on the west and I-10 on the south, with secondary flows between US-93 on the north and I-10 on the south and between I-17 on the north and I-10 on the south.

Figure 14
External-External Auto Trips

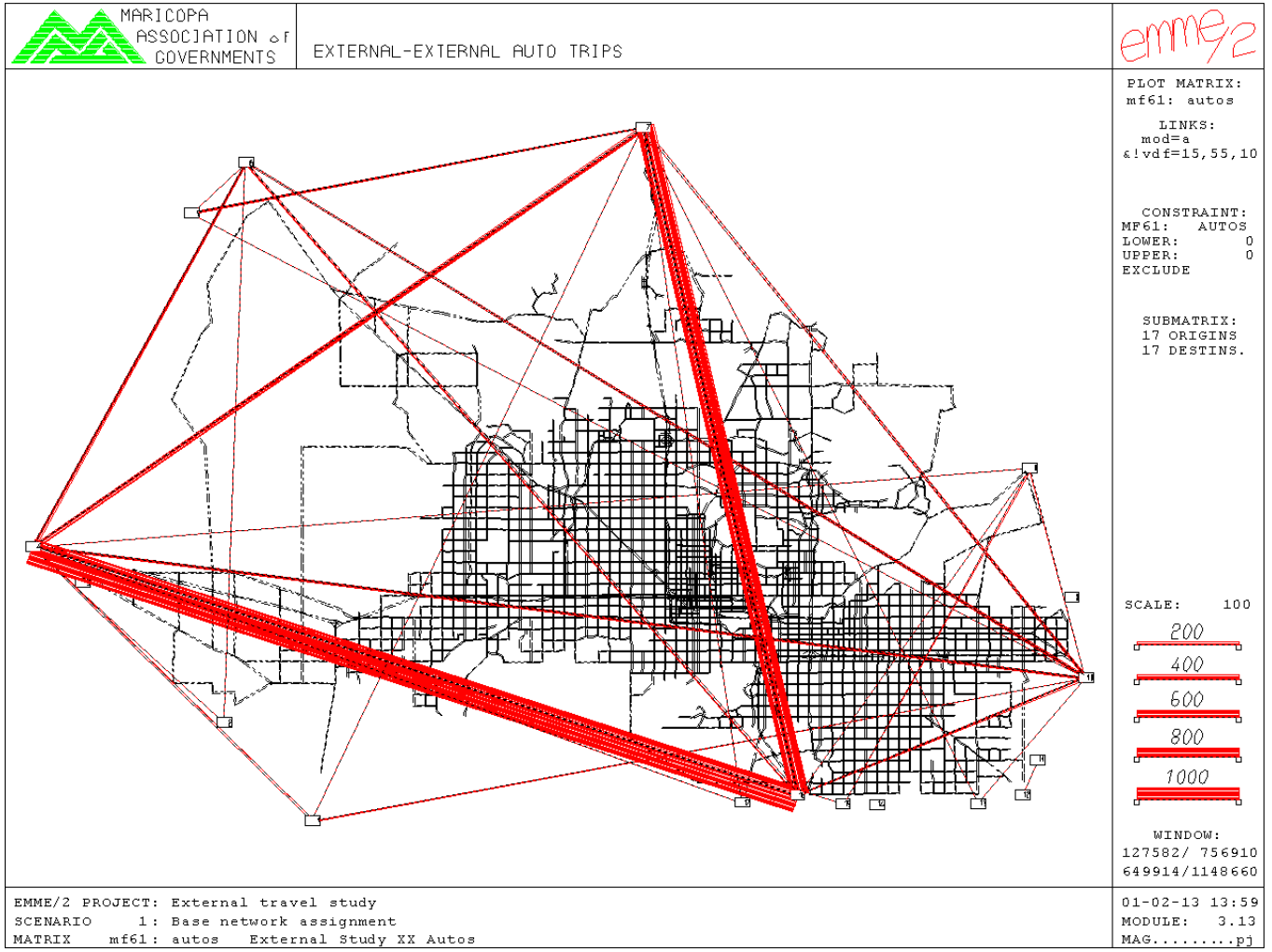


Figure 15
External-External Truck Trips

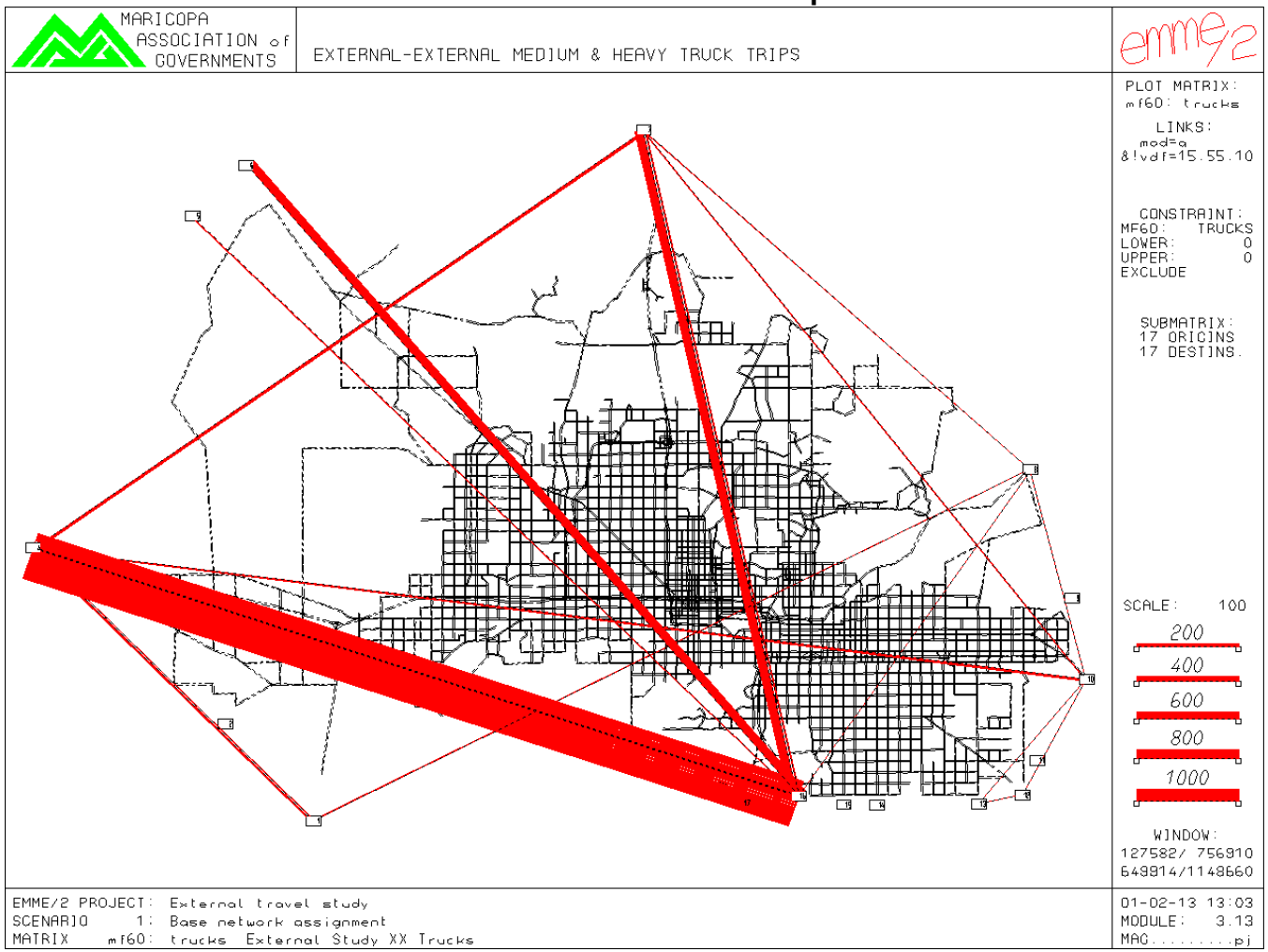


Figure 16 shows the percents of trips by time of day and direction for all stations aggregated to the following three different types:

- Freeways (Stations 4, 7, and 16)
- Highways (Stations 1, 2, 5, 6, 8, 9, 10, 15, and 17)
- Other Roadways (Stations 3, 11, 12, 13, and 14)

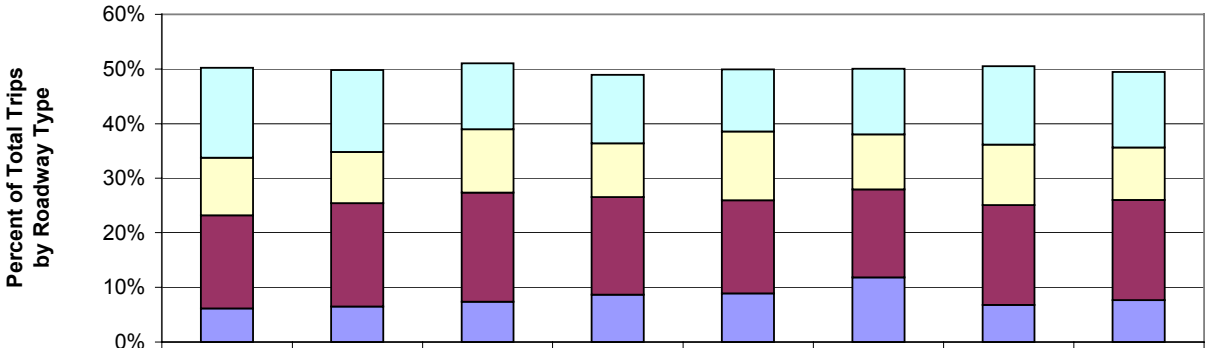
Times-of-day summarized in Figure 29 through 36 were defined as follows:

Time Period	Definition
AM Peak	6:00 AM – 8:59 AM
Midday	9:00 AM – 2:59 PM
PM Peak	3:00 PM – 5:59 PM
Night	6:00 PM – 5:59 AM

Figure 16 also shows the summaries for all roadway types combined.

Two bars are shown for each station or roadway type—one for the in-bound direction percents by time of day and one shows the outbound percents. The percentages for both bars sum to 100 percent (within ±1 percent due to rounding error), with most individual bars summing to approximately 50 percent. When stations are aggregated to the three roadway types, total in-bound and out-bound trips are very close to 50 percent for each direction

Figure 16
Total Trips by Time-of-Day and Direction by Type of Roadway



	Freeway In-Bound	Freeway Out-Bound	Highway In-Bound	Highway Out-Bound	Other Road In-Bound	Other Road Out-Bound	Total In-Bound	Total Out-Bound
Night	17%	15%	12%	13%	11%	12%	14%	14%
PM	11%	9%	12%	10%	13%	10%	11%	10%
Midday	17%	19%	20%	18%	17%	16%	18%	18%
AM	6%	7%	7%	9%	9%	12%	7%	8%

Roadway Type

Note: In-Bound and Out-Bound percentages sum to 100% for each roadway type.